

OECD Composite Leading Indicators

a tool for short-term analysis

The leading indicator approach is based on the view that market-oriented economies experience repetitive and non-periodic fluctuations of economic activity. During the 1980's the OECD developed its system of leading indicators and business cycle analysis to provide economic analysts with early signals of turning points in economic activity. This information is of prime importance for economists, businesses and policy makers to enable correct analysis of the current economic situation and for the anticipation of economic developments. Composite Leading Indicators (CLI) data are compiled and disseminated by the Statistics Directorate of the OECD.

Within the OECD, CLI results are widely disseminated to in-house users. In particular, analysts in the Economics Department responsible for country forecasts, use CLI results for judgmental analysis of the current state of the economy. In addition, the Economics Department is currently implementing the NEFTCI method^a which calculates an explicit probability of turning points for the total economy, using CLI data. The Education, Employment, Labour and Social Affairs Directorate regularly publishes comparisons between the cyclical behaviour of the general economy and specific indicators related to the labour market.

The primary purpose of this document is to show how CLIs can be used in practice to predict economic turning points (peaks and troughs) and to assess the general behaviour of the economy. This is done in Section 4 below. However, it is first necessary to briefly describe the methodology used in the compilation of these indicators. This is done in Section 2. Section 3 presents the different CLI data which are calculated and indicates where they are regularly disseminated. A bibliography listing more detailed descriptions of the methodologies used to compile CLIs, as well as the most recent work carried out by the OECD, are also provided.

1. INTRODUCTION

OECD CLIs are aggregate time series which show a leading relationship with the growth cycles of key macro-economic indicators (the average lead is 6-months). Typically, they are constructed to predict the cycles of total industrial production or gross domestic product in industry, which are chosen as proxy measures for the aggregate economy. CLIs are calculated by combining component series in order to cover, as far as possible, the key sectors of the economy. These component series cover a wide range of short-term indicators such as observations or opinions about economic activity, housing permits, financial and monetary data, etc. The aggregation of components series into the CLI reduces the risk of "false signals", changes in the indicator due to irregular movements which do not correspond to any later developments in the aggregate economy.

CLIs are a straightforward tool for empirical analysis of readily available data. They provide timely and pertinent information, and give a useful overview of the current and future economic situation. Their usefulness in this regard is enhanced by the fact they are released with a shorter delay than direct measures of economic activity. For instance, quarterly gross domestic product data are available with a longer delay and are subject to subsequent revisions. CLIs provide an important aid for short-term forecasts (from 6 to 12 months) of changes in direction of the economy. However, it should also be emphasised that CLIs complement, but cannot substitute for quantitative or long-term forecasts based on econometric models.

At the OECD, official economic quantitative forecasts for Member countries are derived from models. These

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models include simulations of exogenous shocks and equation prediction. Forecasts are published half-yearly in *OECD Economic Outlook*. CLI results are not used directly in these models. However, CLIs provide useful empirical information based on available statistical data. Therefore, they are used at the OECD, among other tools, for the preparation, interpretation and judgmental revision of economic forecasts. Some institutes responsible for economic analysis (including Statistics Netherlands and the European Commission) use different approaches. These include plugging leading indicator results or cyclical indicators directly into econometric models for the compilation of their forecasts.

Data for OECD CLIs are calculated each month for 22 Member countries and six aggregate geographical zones. These data are available in various publications issued by the Statistics Directorate (for details see Table 1).

2. THE OECD SYSTEM OF LEADING INDICATORS

A brief outline of key aspects of the methodology used to compile the OECD CLIs is presented below. For a more comprehensive description see [1].

The following terminology and definitions are used in the OECD system:

- a peak or a trough is marked by a turning point;
- a phase is the time span between a peak and a trough;
- a cycle is the time span separating two turning points of the same nature (two peaks or two troughs);
- a change in regime is defined as the change between a period of recession and a period of expansion (i.e. trough); or as a change between a period of expansion and a period of recession (i.e. peak);
- the reference series is a proxy measure for the aggregate economy.

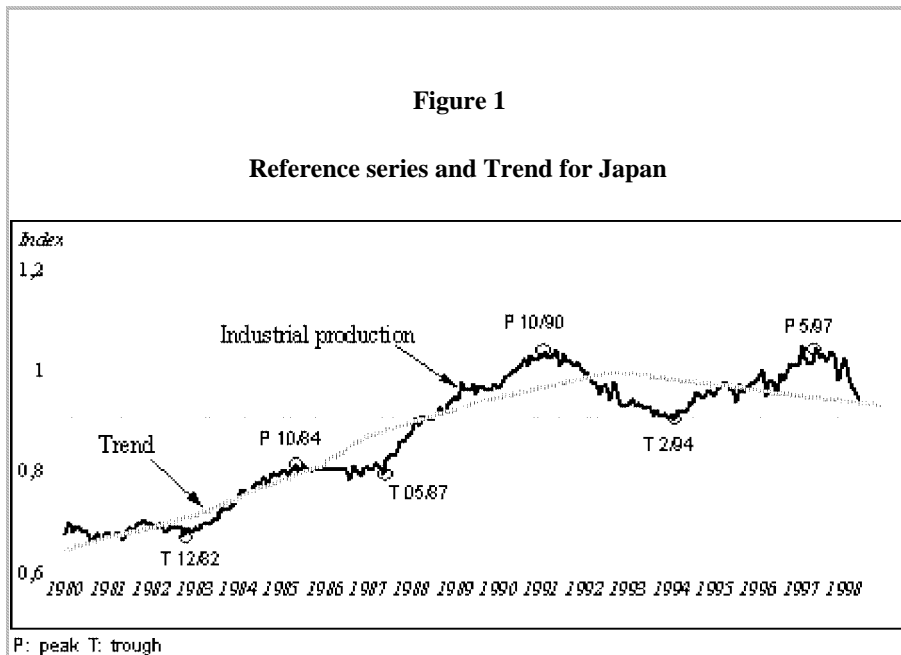
2.1 Reference Series and Economic Cycles

CLIs are constructed to relate to a reference series. An obvious choice for the reference series would be gross domestic product (GDP). However, for the majority of OECD Member countries, the reference series is total industrial production. (It should be mentioned here that many service activities, such as transport, deliveries and repairs, are directly linked to industrial activity.) Industrial production data are generally compiled on a monthly basis, whereas GDP data are only available on a quarterly basis. In addition, industrial production cycles generally lead or are coincident with those of GDP. Therefore, CLIs for total industrial production are leading for the total economy (GDP).

The OECD system of leading indicators is based on the "growth cycle" approach, which measures deviations from the long-term trend. A contractionary phase signals a decline in the rate of growth of the economy though not necessarily an absolute decline in economic activity. This is distinct from classical cycles which are defined as a succession of periods of absolute growth and decline in economic activity. Peaks and troughs of growth cycles tend to appear earlier in time than those of classical cycles.

Long-term trends in time series are estimated using a modified version of the Phase Average Trend method (PAT) developed by the US National Bureau of Economic Research ^b. The PAT procedure requires an initial list of turning points which define the cyclical phases. Initial turning point estimates are calculated using the Bry-Boschan routine (see [2]). The process for deriving the initial list using this procedure entails calculation of an estimated trend for the preliminary identification of peaks and troughs (using a 75-month moving-average). The procedure then executes a series of tests on the deviation from the estimated trend in order to eliminate extreme values. It also specifies a minimum duration of each phase (five months) and the minimum duration for a cycle (15 months). Finally, an OECD expert validates the list of turning points to be used as input to the PAT program. This is mainly to validate each turning point from an economic point of

view and to make the distinction between major and minor cycles (only major cycles are taken into account for PAT trend calculation). Trends in time series are calculated on seasonally adjusted data. See Figure 1 for an example (Japan).



2.2 Selection of Component series

CLIs are constructed from several component series. For each country, these component series are selected according to the following criteria:

- Economic significance: there has to be an economic reason for a leading relationship with the reference series. There are various reasons why series could be suitable components of a CLI. These are indicators which:
 - i. cause fluctuations in economic activity (e.g. economic policy instruments such as short-term interest rates);
 - ii. express the expectations of economic agents (e.g. consumer or business tendency surveys, share prices);
 - iii. measure economic activity at an early stage of the production process (e.g. housing starts, output of intermediate goods); or
 - iv. adjust quickly to changes in economic activity (e.g. overtime work).
- Cyclical behaviour: cycles should lead those of the reference series, there should be no missing or extra cycles, the lead at turning points should be homogeneous over the whole period;
- Data quality: statistical coverage of the series should be broad; series should be compiled on a monthly rather than on a quarterly basis; series should be timely and easily available; there should be no break in time series; series should not be revised frequently.

The cross-correlation of the potential component series with the reference series is also examined at different lead lengths. This criteria is not considered essential in the OECD system as the main objective is to give signals of economic turning points. However, a high cross-correlation (close to 1) means that the component series correctly leads the general cyclical behaviour of the reference series, not only at turning points.

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The final set of component series is selected in order to:

- maximise the performance of the CLI. Performance is evaluated in terms of missing extra cycles, homogeneity of leads at turning points and cross-correlation of the CLI with the reference series;
- cover, as far as possible, the different sectors of the economy (construction, money and finance, manufacturing, labour market, etc.);

The number of series used for the compilation of the OECD CLIs varies for each Member country, but ranges between five and eleven series ^e. The average number of component series is eight.

2.3 Aggregation into the CLI

The component series in a detrended form (deviation from long-term trend) are aggregated into one single composite indicator. Some transformations are required prior to aggregation. These entail:

- Periodicity. CLI data are published with a monthly periodicity. Quarterly component series are converted to a monthly series using linear interpolation.
- Smoothing. In order to reduce the irregularity of the final composite indicator, component series are smoothed according to their MCD ^d;
- Normalisation. All component series are normalised: the cyclical movements are expressed in a comparable form (i.e. for either a multiplicative or an additive model when estimating the trend); the cyclical amplitude is homogenised;
- Weighting. In general, for each country, component series of the CLI have equal weights. Indicators for individual countries are aggregated into geographical zone totals using weights derived from GDP data.

Publication of timely figures for CLIs generally entails the use of an incomplete set of component series. The minimum percentage of component series required varies between 40% and 60% of observations depending on the country. The percentage is established following empirical examination of the availability of component series from the countries.

2.4 Monthly Routine

Each month, historical data for CLIs are calculated for inclusion in different publications produced by the Statistics Directorate. Long-term trends for the component series are re-estimated, and composite indicators are then recalculated from the detrended series. CLI figures are calculated using data available in the OECD's *Main Economic Indicators* database on the Tuesday of the first full week of the month.

2.5 Regular Revisions of CLIs

There is a real need for regular revision of the CLIs. These were created in the mid 1980's, according to the criteria outlined in the previous paragraphs. Since then, a number of the component series have been suspended by national sources. In addition, component series can become outdated either because they become less relevant to the cycles of the reference series or because, over time, their updates have become less satisfactory for the compilation of the composite index. To enable a better trend estimation it is also necessary to review on a regular basis the initial list of turning points used as input to the PAT program (see paragraph 2.1 above). These are possible reasons for deterioration in the quality of the indicators.

Recognising these concerns, the OECD recently completed a review of the CLIs for:

- G7 countries and Belgium (see [Revision of Leading Indicators for the G7 and Belgium](#));
- Norway (see [An Update of OECD Leading Indicators](#)).

3. DISSEMINATION OF CLI DATA

To facilitate use and interpretation of the data, CLIs are presented in a number of forms in OECD publications. The following paragraph describes and compares the presentation formats. Table 1 provides details of the regular dissemination of the data (publications, periodicity and dissemination media).

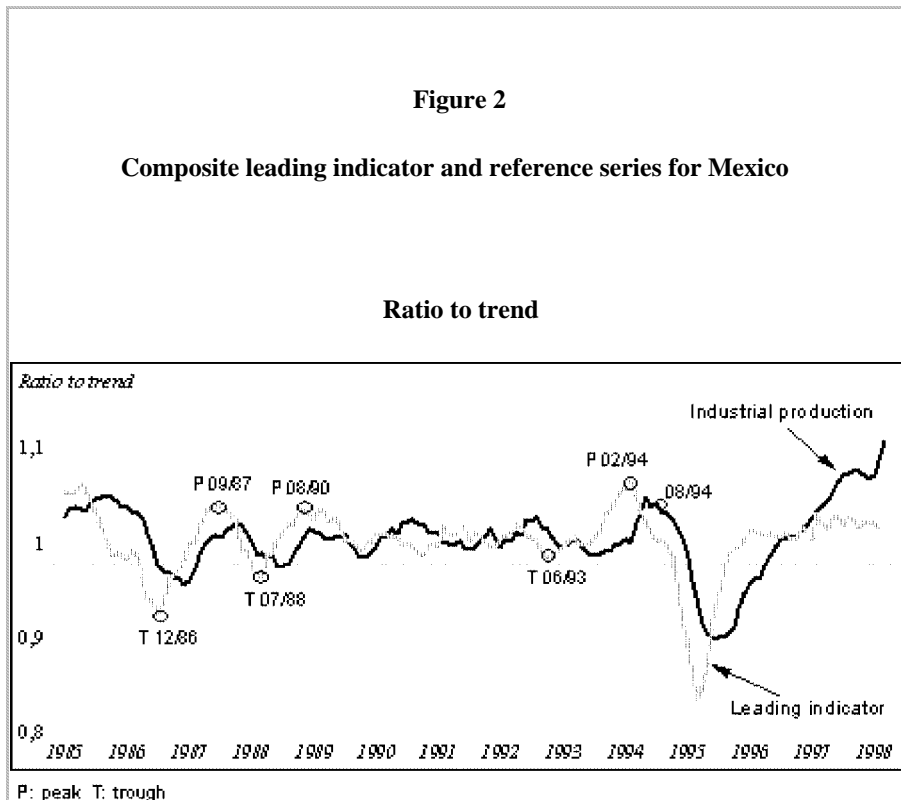
3.1 Types of presentation of OECD CLIs

CLI figures are published in two measurement units; i.e. detrended or trend restored series. It is worth examining each form and their use in predicting economic turning points.

- **Detrended Series**

In OECD terminology this is often called "ratio to trend". It refers to the deviation from the long-term trend of the series and focuses on the cyclical behaviour of the indicator. Hence, this presentation makes it relatively easy to detect a new turning point. A turning point observed in the indicator announces a probable change in regime for the reference series.

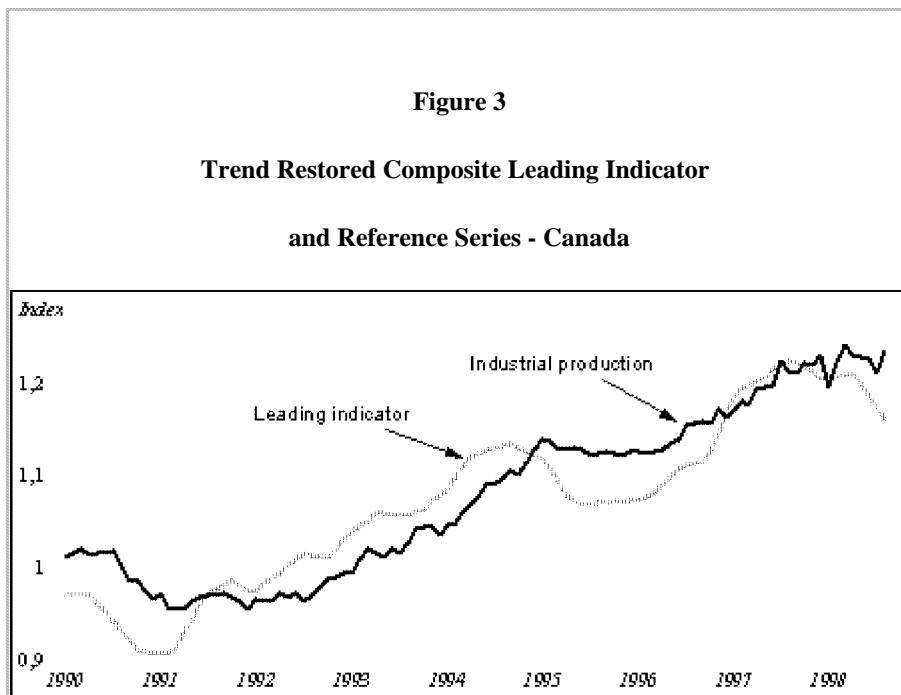
Very often, the CLI is shown along with the reference series. This facilitates comparison of the evolution of both series and ultimately enables users to predict changes in the reference series. The use of detrended series also enables users to assess the forecasting ability of the indicator (i.e. the absence of false signals, homogeneity of lead, etc.) for all historical data. See Figure 2 for an example. In particular, the composite leading indicator presented in this figure provides a clear signal of the peak of the Mexican economy in February 1994 with a 6-month lead (a peak occurred in industrial production in August 1994).



- **Trend Restored Series**

CLIs are also frequently presented in OECD publications in a form directly comparable to the reference series as published by national sources (i.e. in index form with a fixed base year). To enable such direct comparison it is necessary to multiply the indicator in a ratio to trend form by the trend of the reference series. In the OECD system, this procedure is called "trend restoration". See the example for Canada in Figure 3.

This presentation format has many advantages. In particular, it is possible to assess the general fit and to anticipate future developments in the reference series. Obviously, this will provide information about the likely rate and amplitude of changes. However, it is important to emphasise that component series are not selected according to a strict quantitative criteria based on the cross-correlation with the reference series (see paragraph 2.2 above). Therefore, any information on the rate and amplitude of future changes in the reference series cannot be considered as a real quantitative forecast.



3.2 How to Access CLI Data on a Regular Basis

CLI data are available on a regular basis in different OECD publications. These publications are issued by the Statistics Directorate and are available in print and electronic formats. Table 1 below gives details of how to access CLI data. This includes a description of the publications, periodicity and dissemination media. CLI data are presented in publications in tabular and/or in graphical form in all products.

Table 1: Regular Dissemination of CLI Data

Publication	CLI data available	CLI data presentation	Dissemination media
<u>Main Economic Indicators</u> (monthly)	CLI (trend restored)	Tabular form and graphs	Printed edition and electronic products
<u>Hot File</u> (weekly)	CLI (trend restored)	Tabular form	Printed edition and Internet
<u>Monthly Note of Leading Indicators</u> (monthly)	<ul style="list-style-type: none"> ▪ CLI (trend restored) ▪ Derived measures (see 4.2) ▪ Monthly analysis of most recent developments ▪ List of turning points and component series (for G7 countries) 	Tabular form and graphs	Printed edition and Internet
<u>Leading Indicators and Business Tendency Surveys</u> (monthly)	<ul style="list-style-type: none"> ▪ CLI (trend restored and ration to trend) ▪ Reference series (ration to trend) ▪ Component series (ratio to trend) 	Tabular form	Electronic product (diskette)
<u>Historical Statistics</u>	Evolution and cyclical behaviour of OECD economics	Graphs	Printed edition and electronic product

4. PRACTICAL USE OF OECD CLIs FOR SHORT-TERM ANALYSIS

As mentioned in the introduction to this paper the main function of OECD CLIs is to forecast the turning points of the economy. CLIs represent a straightforward and useful tool for the analysis of current and future economic situations. The objective of this Section is to give key elements for the interpretation of CLIs results and for their practical use. In particular, this section describes:

- factors that need to be taken into consideration when making such forecasts;
- how CLIs can be used by analysts for forecasting; and
- an assessment of the reliability and robustness of turning points.

4.1 Key Issues in the Use of CLIs for Predicting Turning Points - Impact of Data Revisions

In theory, the signal of a turning point by the CLI would certainly announce a turning point in the reference series. However, in practice, the **perfect** composite leading indicator does not exist. Even if the historical performance of the indicator is good over the whole period, there is always a possibility of false or missing signals (i.e. indication of turning points that do not materialise). These can be due to structural changes, unusual phenomena or a statistical accident. It is important to keep these restrictions in mind when making forecasts with CLIs.

For example for the most recent period, it may not always be easy to distinguish the signal of a turning point from irregular movements in the CLI. This is due to the fact that CLI data are continuously revised and also because in practice, the CLI movements are fairly erratic, even if they are calculated from smoothed series. For these reasons, it could be quite dangerous to draw definitive conclusions from one or two months of movements in the indicator. For an accurate prediction it is worth examining different derived measures and statistics calculated for the CLI (see below).

The irregularity in the CLI is partly due to the fact that the indicators are released from an incomplete set of data (see paragraph 2.3). Particular reasons for revisions of the indicators are changes in the long-term trend estimates when new data are available and routine revision of the reference or the component series. In particular, end of period trend estimates using the PAT method, may be substantially revised.

A number of different derived measures are available in different OECD publications. These measures assist users in the analysis and interpretation of recent developments in the CLI, trend restored. These are:

- The **1-month percent change** of the composite indicator.

This gives an indication of the most recent changes in the indicator. A change in the direction of the indicator or a continued inflection in the rate indicates a turning point. In practice, a 3-month rule can be applied for the identification of a turning point. That is, three consecutive months of negative/positive change will give a signal for a peak/trough;

- The **12-month percent change** of the composite indicator and the **12-month trend rate** for the reference series.

The 12-month percent change of the indicator is a rate where the initial value is a 12-month centred average (the rate is calculated by dividing the figure for a given month m by the 12-month moving average centred on $m-12$). This rate gives early warnings of turning points in the CLI. The timing of the peaks/troughs corresponds to the local maximum/minimum of the rate. For perfectly well-behaved cycles, this gives signals about 12 months ahead (in practice however, time series are not perfectly well-behaved).

This rate can also be compared with the 12-month trend rate of the reference series. A change in the rate from above to below the long-term trend confirms that a peak has been reached (descending phase of the cycle). Reciprocally, a trough will be confirmed by a rate below trend that changes to above the trend.

An assessment of the ability of these measures to predict turning points has been done for the United States over the period 1980-1998. Signals given by the measures have been compared to the turning points in the reference series. Different statistics have been calculated including the: number of leads/lags in months and the number of missing and extra signals (see Table 2 below). The 1-month percent change gives early signals of all turning points, except in January 1989. The 12-month percent change gives signals of all the turning points with a longer lead. Both measures give extra signals of turning points. Over the period 1980-1998, there are no missing signals.

Table 2

Derived Measures - Signals of Turning Points

United States 1980-1998

Signals of turning points		
Leads (-) and lags (+) in months		
Turning points in Reference series^e	1-month % change in CLI	12-month % change in CLI
(Jul 1980) Trough	-5	-3
(Jul 1981) Peak	-2	-3
Dec 1982 Trough	-5	-7
Jun 1984 Peak	-3	-11
Sep 1986 Trough	-10	-3
Jan 1989 Peak	+2	-1
Mar 1991 Trough	-1	-2
Sep 1997 Peak	-1	-2
Missing (m) or Extra (x) signals	4 x	2 x

It is useful to analyse the results of all the derived measures described above when approaching turning points. These provide complementary information. All these measures should be used with care. Over the whole period, they have provided useful early signals of peaks and troughs, but also some false signals. See also ([3]). These measures give some information about the current situation, but have to be considered only as part of the total information available. A correct and reliable analysis for the detection of a turning point should be based on the analysis of these measures as well as on a graphical examination (CLI and reference series). It may also be worth examining the percentage of components signalling a turning point and the strength of the signals given by individual component series.

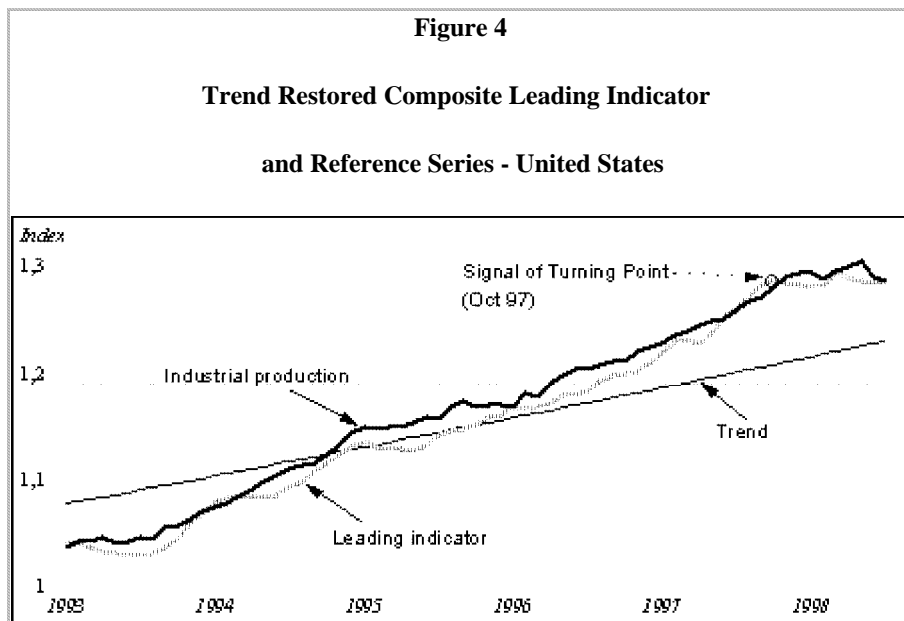
4.2 Examples of Analysis Using OECD CLIs

A practical analysis of the use of CLIs is presented below for the United States. This analysis is based on statistical data published in the *Monthly Note of Economic Leading Indicators* in September 1998. Table 3 shows the CLI for the United States ^f in a trend restored form, and the 1-month and 12-month percent changes in the CLI.

Table 3: Composite Leading Indicator for the United States

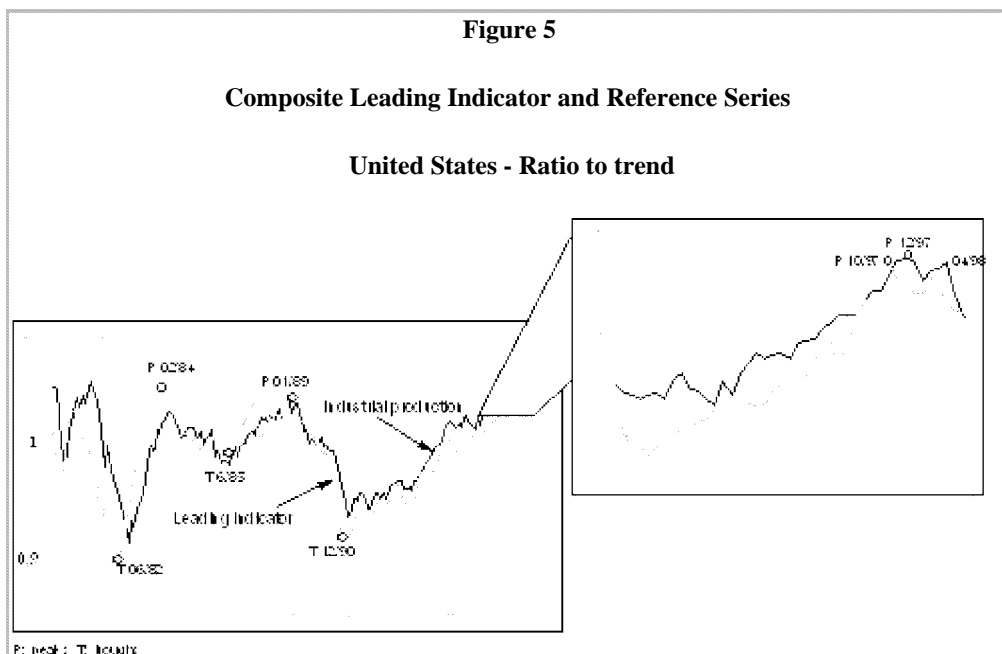
	CLI (trend restored)	1-month percent change	12-month percent change
Jun 1997	125.0	1.2	5.7
Jul 1997	125.9	0.7	6.1
Aug 1997	127.0	0.9	6.6
Sep 1997	127.9	0.7	6.8
Oct 1997	128.5	0.5	6.9
Nov 1997	128.2	-0.2	6.2
Dec 1997	127.9	-0.2	5.5
Jan 1998	127.8	-0.1	4.8
Feb 1998	128.0	0.2	4.5
Mar 1998	129.0	0.7	4.6
Apr 1998	128.8	-0.2	3.9
May 1998	128.4	-0.3	3.0
Jun 1998	128.2	-0.2	2.3
Jul 1998	128.4	0.1	2.0
Latest trend rate \hat{g} : 2.4			

Examination of the 1-month percent change first shows an inflexion in the indicator and then a clear change of direction in November, with three consecutive negative changes. This gives a first signal for a turning point in October. This signal is confirmed by examination of the 12-month percent change (maximum in October 1997) which becomes lower than the latest trend rate in June 1998. Cycles are measured as the deviation from trend, thus, a 12-month percent change which becomes lower than the trend rate indicates that the descending phase of the cycle (from peak to trough) has already started. Therefore, the peak has been reached. Figure 4 shows the CLI and the reference series in a trend restored form.



Further investigation, in particular a graphical examination of the ratio to trend series, is necessary to validate the probable turning point. Figure 5 shows the CLI along with the reference series in a detrended form. The ratio to trend series confirms a clear peak in the CLI in **October 97**. The peak materialises in the industrial production series in **December 97** (first slowdown in activity). In fact, the evolution of the industrial production series was quite uncertain during the period between December 1997 and April 1998. The decrease in the ratio to trend series appears clearly only after that date (see Figure 5). The CLI gives an early and clear signal of the peak in industrial production.

Given the average timeliness of the component series, CLI data for the United States are available two months after the end of the reference period (i.e. CLI data for October 1997 were available and published in December 1997). Industrial production data are also available two months after the end of the reference period.



It is useful to carry out further investigation of the signal of the turning point. This can be done by a detailed examination of the ratio to trend of each component series used to compile the CLI. An early signal of a turning point is present in five of the eight component series (63%). These are:

- New Orders for Durable Goods (peak in November 97)
- Share Prices, Common Stock (peak in October 97)
- Change in Prices of Sensitive Materials (peak in August 97)
- Contracts and Orders for Plant and Equipment (peak October 97)
- Consumer Confidence Indicator (peak July 97)

The remaining component series (Weekly Initial Claims; Dwelling Construction Started; Treasury Bill Rate) do not show early signals of the peak.

4.3 Assessment of Robustness of Early Signals Provided by CLIs

The reliability of signals provided by CLIs is a key element for their regular use by economists and analysts. Different simulations were carried out to assess the predictive ability of the CLIs and the robustness of the

signals of turning points.

Some simulations were carried out to test the predictive ability of the CLI for Mexico to signal the 1994 crisis (for more details see ([5], [6]). The Mexican crisis was characterised by a peak in the reference series in August 1994. The CLI for Mexico was first compiled in 1996, that is, after the crisis. Thus, for the purpose of the simulation, different CLIs were calculated using:

— *a posteriori* first indicator was calculated using component series available for the information about the 1994 crisis. The entire period (1980-1996);

— *a priori* information about the crisis. The second indicator was calculated with component series as they existed through the summer of 1994.

Both indicators give early and repeated signals of the subsequent recession with a 6-month lead. This shows the ability of the composite leading indicator for Mexico to give clear and robust signals of the crisis.

Other simulations have also been carried out to compare CLIs as they are first published, i.e. calculated from an incomplete set of component series, with the final indicators (see [4] for detailed results). The successive monthly revisions of the CLIs were analysed for the majority of OECD Member countries in terms of the:

- mean of the revisions;
- mean absolute revision, i.e. the average of the revision without regard to sign.

The main results of this analysis is that monthly revisions are fairly small and that there is no trace of bias. The third estimate of the CLI gives a much improved performance and subsequent revisions are not significant.

Finally, the current performance of the indicators in predicting turning points was compared with the final indicator. The main conclusion is that the indicators give information which, in most cases, is not significantly revised. This refers both to the timing of turning points and the evolution of the CLI over the whole cycle. These simulations were carried out for the majority of OECD Member countries.

5. FUTURE OECD ACTIVITIES IN THE AREA OF LEADING INDICATORS

Listed below are a number of proposed future OECD activities in the area of leading indicators:

- review of the presentation of CLI data in OECD publications (tables and graphs);
- continuation of the review of currently published CLIs: updating the input list of turning points for the PAT program; reviewing the component series;
- assessment of the methodology currently used to compile OECD CLIs and implementation of proposed changes if necessary;
- calculation of CLIs for new OECD Member countries;
- development of methodologies to predict turning points;
- continued participation at international meetings on leading indicators and presentation of recent OECD activities in this area.

Notes

a) Sequential probability method proposed by NEFTCI (1982). The probability of a turning point is calculated sequentially using current information together with the previously estimated posterior probability. The decision rule determining when a turning point has come about is associated with this method by appending a critical threshold value for the sequential

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probability.

b) The trend is estimated by splitting the series into cyclical phases using a preliminary estimation of peaks and troughs (Bry-Boschan routine). Averages of the data over each phase (phase averages) are calculated and a three-month moving average of the phase averages is computed. The values obtained are located at the midpoint of the three-phase period, called "triplets". A second approximation of the trend is thus calculated by connecting midpoints of the triplets. The level of the final trend is then adjusted to match the level of the original data. The trend is extrapolated to the end of the series by computing the slope from the last triplet mid-point. Finally, the level of the trend of the last segment is adjusted to match the level of the original data. See ([1]) for more details.

c) Except for Luxembourg: two component series.

d) Months for Cyclical Dominance. For details see [1] page 42.

e) Minor cycles appear in brackets.

f) For the historical performance of the CLI refer to paragraph 2.5.

g) 12-month percent changes of the trend for the reference series.

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See also Internet: <http://www.oecd.org/std/>.

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